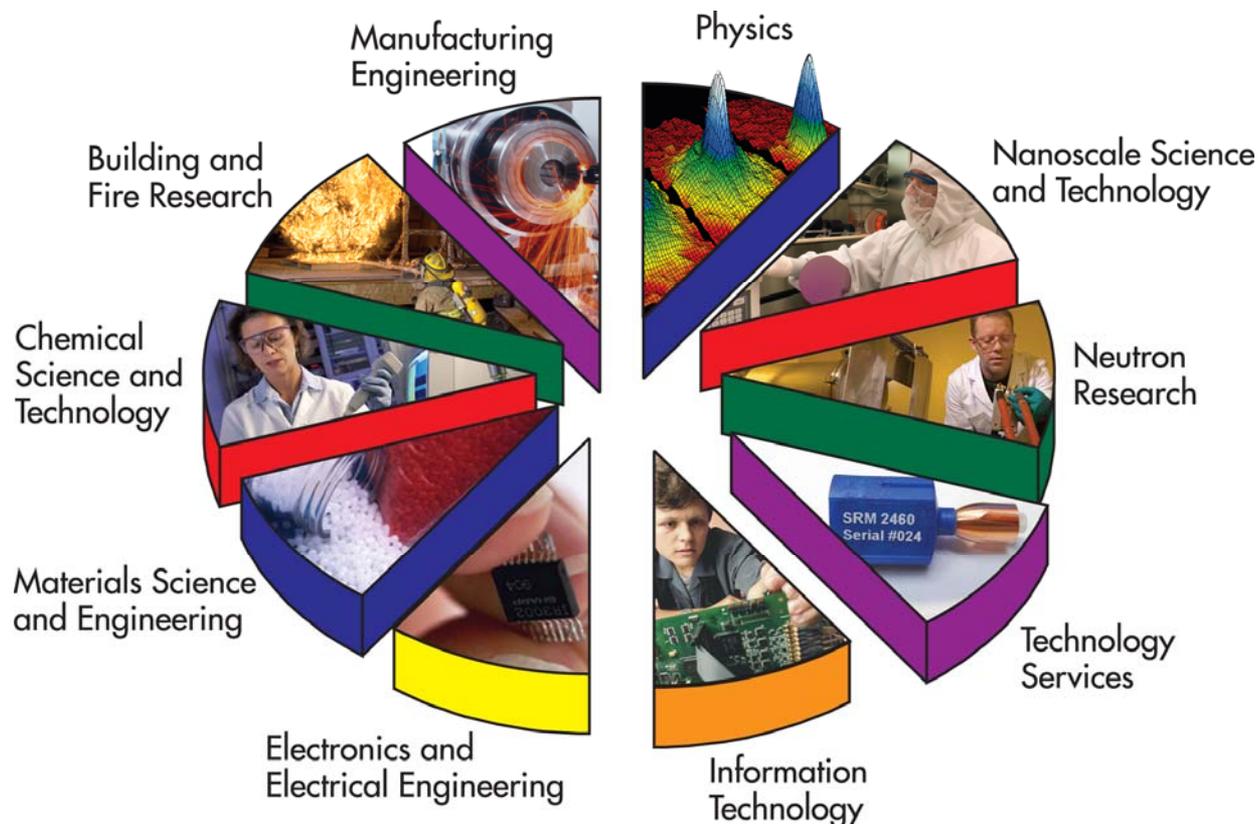


NIST has traditionally focused on the physical science and engineering disciplines



Bioscience and Health has been identified as an area for significant growth at NIST

Overview of Partnerships with

- The Hollings Marine Laboratory
- The University of Maryland Biotechnology Institute

NIST Visiting Committee on Advanced Technology

June 10, 2008

NIST will strategically use external partnerships to complement our facilities and expertise to enable us to better address our mission

NIST has been collaborating with NOAA In Marine Environmental Measurements for 30+ years

Preparing for the Trans-Alaskan Pipeline

Sample collection and analysis

Study was part of a three year NOAA project to determine baseline hydrocarbon levels in Prince William Sound before pipeline

First protocols established for environmental sample collection for trace organic analysis

Work led to

- establishment of NIST's world-class program in Organic Analytical Chemistry
- commercial products/processes such as solid phase extraction and HPLC-based sample clean-up



Willie May and Harry Hertz collecting samples in Alaska in 1975

Hollings Marine Laboratory

Mission: To provide the science and biotechnology to understand linkages between environmental condition and the health of marine organisms and humans



**A National Center of Excellence
For Oceans and Human Health**

NIST Role in Ocean and Human Health Program

NIST is providing the measurement science and standards for:

- Detecting, identifying and determining the sources of human pathogens in coastal waters.
- Identifying and quantifying emerging chemical contaminants in coastal waters and assess their potential effects.
- Assessing the health status of key marine organisms using genomic technology (oyster and shrimp).
- Monitoring and assessing coastal environmental quality and associated public health threats.



HML is One of Five Research Facilities on the Fort Johnson, South Carolina Campus



NOAA: Center for Coastal Environmental Health and Biomolecular Research

126 personnel (55% contractors)



SCDNR: Marine Resources Research Institute

120 personnel



CofC: Grice Marine Laboratory

16 faculty + 48 MS students



MUSC: Marine Biomedicine and Environmental Sciences

41 faculty + 20 PhD students



Total HML: 120 personnel

NIST: 25 personnel

NIST researchers work side-by-side with scientists from the other four partners on research focused on gaining a better understanding of the linkages between marine environmental conditions and the health of marine organisms and humans.

Hollings Marine Laboratory

A Unique Partnership established in 2002

- **HML Partners**

- **Academic: MUSC and CofC** provide access to faculty and to students – undergraduate, graduate, and post-doctorate
- **Federal Agencies: NIST and NOAA**
- **South Carolina Department of Natural Resources**



- **Overarching Joint Project Agreement** clearly defines:

- Partnership and roles
- Process for strategic alignment of goals
- Executive and Science Boards collaboratively define strategic research directions



NIST Facilities at HML:

- **Marine Environmental Specimen Bank**
- **Nuclear Magnetic Resonance**
- **Inorganic Analytical Laboratories**
- **Organic Analytical Laboratories**
- **Reference Material Production**

NIST Occupies:

- ~1000 sq. ft. of Office Space (15%)
- ~11,000 sq. ft. of Lab Space (45%)

NIST Activities at HML:

- **Analytical Methods Development**
Trace metal speciation and Chemicals of emerging environmental concern
- **Bioanalytical Technologies for Assessment of Marine Mammal Health**
- **CRMs and other Measurement QA activities**
- **Chemical Reference Data**
- **Environmental Specimen Banking**

Nuclear Magnetic Resonance Instruments at Hollings Marine Lab



- **800 MHz standard-bore system and shielded 700 MHz standard-bore system**
- **Both instruments have:**
 - TCI-triple resonance, single gradient cryoprobes
 - 5 mm room temperature triple-resonance, triple gradient probes
 - 1 mm room temperature triple-resonance, single gradient probes
- **In addition, the 700 MHz instrument has:**
 - High-resolution Magic Angle Spinning (HR-MAS) probe
 - HPLC/MS/NMR accessory

Examples of current and planned activities:

- Structural biology to support growing bioscience and health activities
- Metabolomics to support studies of
 - human health status assessments (with NIH)
 - response of marine organisms to various stressors (with MUSC)
- Chemical purity determination

Impact of NIST Specimen Banking Activities

In support of temporal investigations of the health status of organisms and their environment



- Decline in lead levels in human populations in the USA (Zeisler *et al.* 1984)
- Determination of genetic separation of beluga whale, *Delphinapterus leucas*, populations (O'Corry-Crowe *et al.*, 1997)
- Determination of organoarsenic compounds in ringed seal, *Phoca hispida*, livers (Goessler *et al.*, 1998)
- Polar bear nutrition studies (Kenny *et al.*, 1999)
- Geographic and temporal comparisons of persistent organic pollutants and mercury in Alaska seabird colonies (Christopher *et al.* 2002; Vander Pol *et al.* 2004; Day *et al.* 2006; Vander Pol, Day and Point, ongoing)
- Temporal changes in brominated flame retardants in California sea lions and Atlantic white-sided dolphins (Stapleton *et al.* 2006; Tuerk *et al.* 2005; Peck *et al.* in press)
- Temporal changes in organomercury and organotin compounds in Alaska marine biota (Point *et al.*, ongoing)
- Temporal changes in Alaska Arctic food webs using stable isotopes and fatty acids as indicators (Reynolds and Wetzel, Mote Marine Laboratory ongoing)
- Temporal changes in chiral signatures of chlorinated pesticides in sediments (Xiqing *et al.*, Boston University, ongoing)
- Temporal changes in PBDEs and PFCs in beluga whales from Alaska (Keller *et al.*, ongoing)

HML Partners Determine Activation Mechanism for *Deadly Marine Toxin*

Issue: In a long-standing mystery surrounding occasional mass fish kills on the East Coast, a normally inoffensive algae, *Pfiesteria piscicida*, can suddenly start producing toxins (Red Tide event) that can be lethal to fish and cause serious health effects in humans

- Large federal scientific studies/investment have produced conflicting research results regarding the cascade of events leading to a *pfiesteria* toxicity episode.

NOAA Role: Mass cell culture and purification of photosensitive toxin under red light; and structural characterization of toxin

NIST Role: Sophisticated analytical mass spectrometric methods developed at NIST:

1. identify Fe, S and Cu, and quantification of Cu in active (fish killing) isolates
2. demonstrate compound degradation over time complementing structural characterization studies

MUSC Role: Photo degradation studies and chemical modeling studies that indicated possible metal-sulfur based radical involvement



“Red Tide”

These studies led to the identification of a class of light-sensitive, water-soluble, organically ligated copper-sulfur complexes that are responsible for Pfiesteria toxicity. The researchers determined that certain environmental cues must be present to initiate a toxic episode. This work is leading to development of a more systematic approach for managing this problem.

Hollings Marine Laboratory - A Unique Partnership

- **HML partnership provides partners:**
 - Access to state-of-science facilities and instrumentation
 - Collaborations with and access to scientists representing a broad range of disciplines
 - Enhanced education and training opportunities
- **NIST Charleston staff are administratively integrated into cohesive CSTL framework.**
- **By having part of its staff located at the HML and working collaboratively with scientists from partner institutions:**
 - NIST is better able to develop programs within its mission that respond to the needs of the marine research community
 - NIST is able to leverage its expertise in measurement science to address biological problems of national and global importance.
 - Through its association with two institutions of higher learning, NIST is able to influence and contribute to the training and development of the nation's future scientists.

Center for Advanced Research in Biotechnology (CARB)

Currently one of four centers within UMBI

History:

In 1985, NIST's CSTL and the University of Maryland joined with Montgomery County, MD to establish the Center for Advanced Research in Biotechnology (CARB)

- **Intent**

- NIST to provide expertise in metrology
- UMD to provide expertise in biology

- **Initial research focus**

- Work on the relationship between structure and function in biomolecules
- Development of new technologies for the measurement, analysis and design of biomolecules

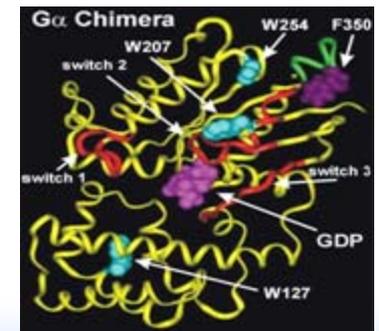
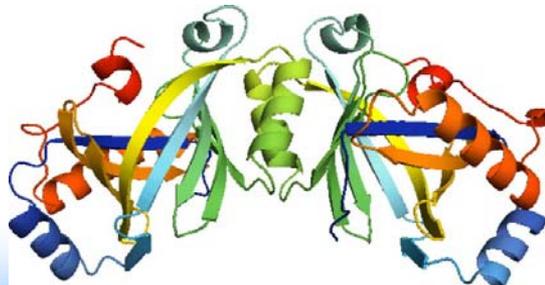


CSTL/CARB Program Activities

Over the years, ~10 to 12 NIST staff in the **Structural Biology** Group of CSTL's Biochemical Science Division were/are physically located at CARB.

Current activities include:

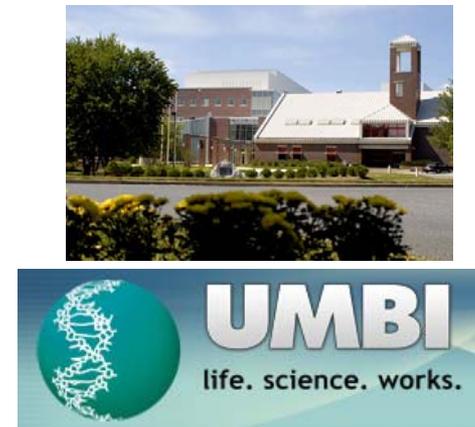
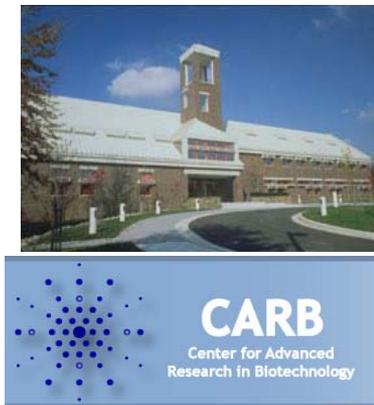
- Methods to obtain 3-D structures of proteins and DNA
- Tools to determine the dynamics of proteins, nucleic acids, and protein-nucleic acids complexes in solution
- Study of macromolecular structure, interactions and function
 - Studies include understanding the role of RNA/DNA structures and interactions in plasmid copy number regulation and retroviral replication
- Study of mutation and evolutionary genomics
 - Studies include understanding how biases in mutation bias the course of evolution
- Improved bioinformatics tools



While reasonably productive, it became apparent that the collaborative model initiated in 1985 has not fully leveraged the strengths of both organizations:

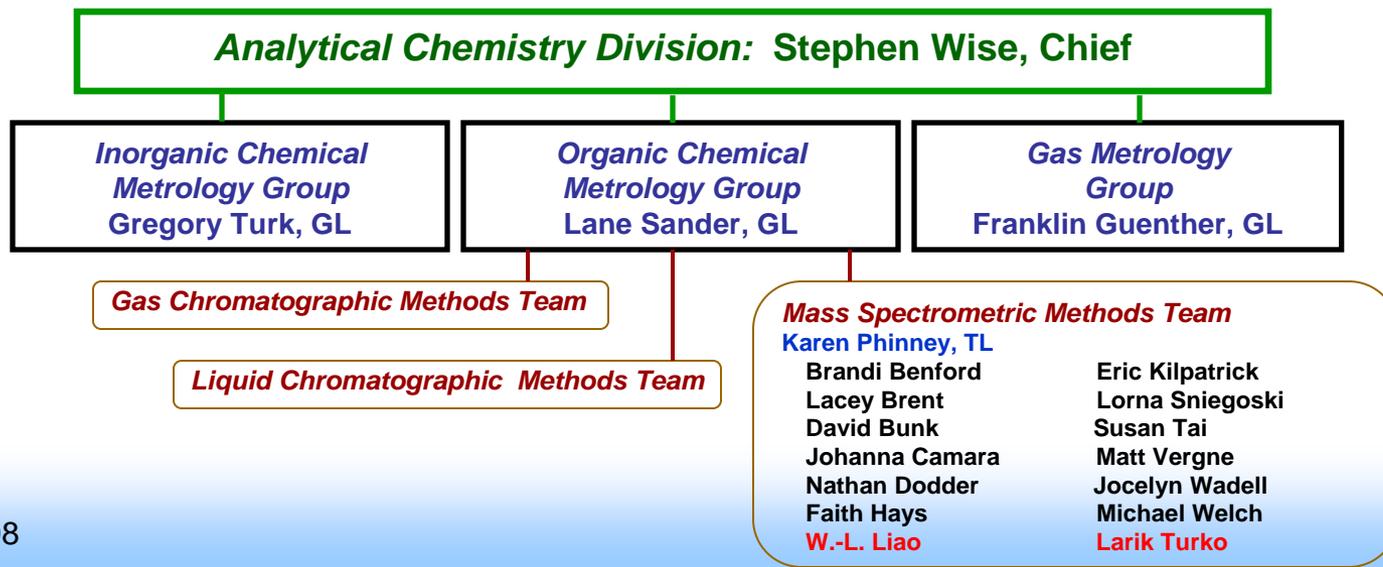
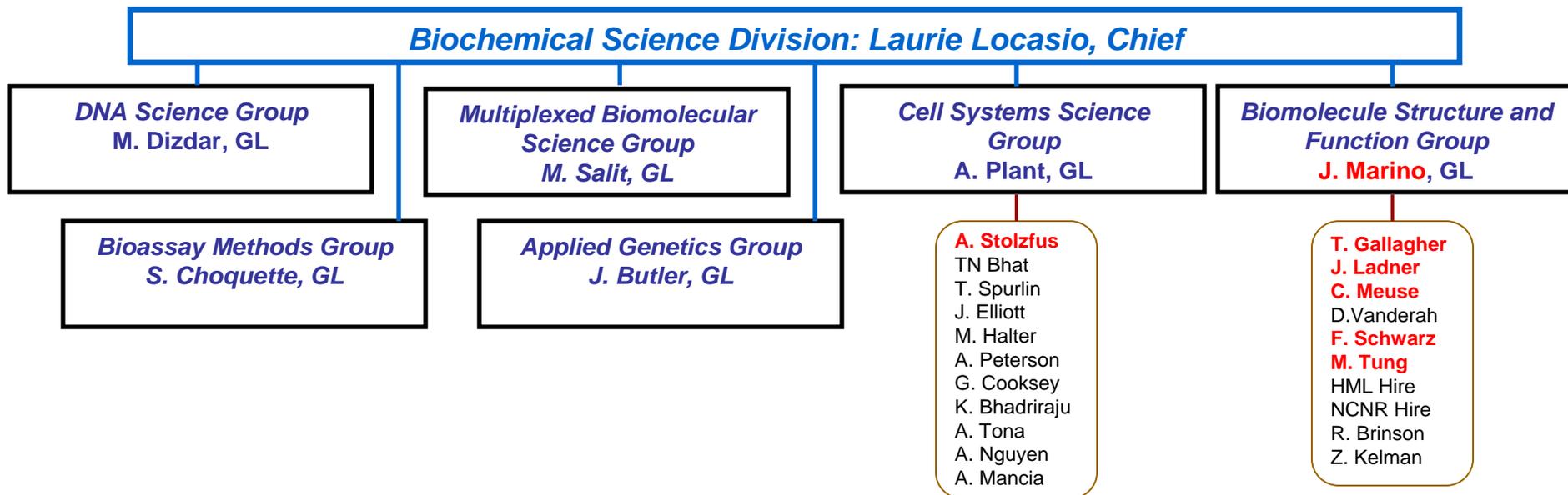
- CARB talent and capabilities have been somewhat isolated and not benefited fully from NIST capabilities and strengths
- NIST interest in the biosciences has broadened and has not fully tapped into and benefited from the excellent and rapidly expanding capabilities at UMBI

UMBI capabilities in protein science map well to
NIST planned program expansion in protein measurement science



A new model for interaction was needed

Integrating NIST CARB Staff into CSTL Programs



Actions to Expand Scope of Partnership

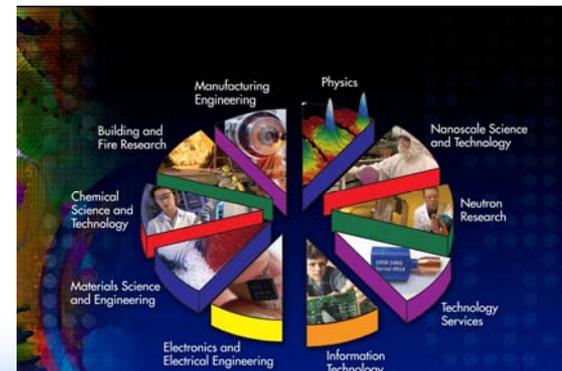
New MOU signed in August 2007

- **Partnership will complement NIST expertise and facilities in areas of strategic interest to NIST**
 - *bioenergy*
 - *bioimaging*
 - *bioinformatics*
 - *protein measurement science*
- **Partnership expanded to**
 - **NIST level, not CSTL only**
 - **all four UMBI Centers, not CARB only**



UMBI President, Dr. Jennie Hunter-Cevera, signs agreement expanding joint research and educational activities with NIST Director, Dr. William Jeffrey.

- **CARB**
- **Center for Biosystems Research**
- **Center of Marine Biotechnology**
- **Medical Biotechnology Center**



Actions to Strengthen and Leverage Partnership

New MOU

- Provides for:
 - *interdisciplinary research programs that*
 - *leverage NIST's measurement and analysis expertise across the range of physical sciences with UMBI's resources;*
 - *broaden access to the specialized research facilities of both institutions;*
 - *increased exchange of staff through temporary appointments;*
 - *training programs for students that capitalize on the unique expertise and facilities at both institutions*

**NIST and UMBI are jointly sponsoring
International Symposium in October 2008:
“Measurement and Standards Barriers to
Innovation in the Biosciences”**

International Conference - October 20-22, 2008

“Accelerating Innovation in 21st Century Biosciences: Identifying the Measurement, Standards, and Technological Challenges”

Co-Hosted by:



Location:

National Institute of
Standards and Technology
(NIST)
Gaithersburg, MD USA

Registration will open after July 1,
space is limited, register early !

For conference information, updated list of
plenary speakers, and registration:
www.cstl.nist.gov/Biosciences.html

Sponsorship opportunities are still available!

Email: barriersworkshop@nist.gov



New Strategic Partnerships

New strategic partnerships/alliances in various stages of development include:

- *Institute for Systems Biology*
- *University of Alabama Birmingham*
- *Quantitative Imaging Biomarker Alliance*
- *U.S. Food and Drug Administration*
- *National Cancer Institute Center of Cancer Research*
- *U.K. National Institute of Biological Standardization and Control*



Thanks for Your Attention

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